

## DOCUMENT RESUME

ED 107 991

CE 004 204

AUTHOR Pucci, Alex L; Reichel, George F.  
TITLE An Analysis of the Welding Occupation.  
INSTITUTION Ohio State Dept. of Education, Columbus. Div. of Vocational Education.; Ohio State Univ., Columbus. Trade and Industrial Education Instructional Materials Lab.  
SPONS AGENCY Office of Education (DHEW), Washington, D.C.  
PUB DATE [75]  
NOTE 81p.; For related documents, see CE 004 160-203, CE 004 205-206, CE 004 263-268, and CE 004 425-427  
EDRS PRICE MF-\$0.76 HC-\$4.43 PLUS POSTAGE  
DESCRIPTORS Communication Skills; \*Job Analysis; Knowledge Level; \*Metal Working Occupations; \*Occupational Information; Safety; Skill Analysis; Skill Development; Skilled Occupations; \*Task Analysis; Task Performance; Trade and Industrial Education; Welders; \*Welding; Work Attitudes

## ABSTRACT

The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the welding occupation. It includes the basic manipulative skills and technical information in the following four areas: oxy/acetylene, electric arc, tungsten inert-gas arc, and metallic inert-arc welding. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. The four areas are broken down into a number of tasks and for each task a two-page table is presented, showing on the first page: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety--hazard; and on the second page: science; math--number systems; and communications (performance modes, examples, and skills and concepts). Also included in the document are a brief note on abbreviation of welding terms, and 2 sections on safety (eye protection and general safety practices). (BP)

\*\*\*\*\*  
\* Documents acquired by ERIC include many informal unpublished \*  
\* materials not available from other sources. ERIC makes every effort \*  
\* to obtain the best copy available. nevertheless, items of marginal \*  
\* reproducibility are often encountered and this affects the quality \*  
\* of the microfiche and hardcopy reproductions ERIC makes available \*  
\* via the ERIC Document Reproduction Service (EDRS). EDRS is not \*  
\* responsible for the quality of the original document. Reproductions \*  
\* supplied by EDRS are the best that can be made from the original. \*  
\*\*\*\*\*

CE004204

ED107991

# WELDING

Instructional Materials Laboratory  
Trade and Industrial Education  
The Ohio State University

U.S. DEPARTMENT OF HEALTH  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION  
THIS DOCUMENT HAS BEEN REPRO-  
DUCED EXACTLY AS RECEIVED FROM  
THE PERSON OR ORGANIZATION ORIGIN-  
ATING IT. POINTS OF VIEW OR OPINIONS  
STATED DO NOT NECESSARILY REPRESENT  
THE OFFICIAL POSITION OR POLICY OF  
THE NATIONAL INSTITUTE OF  
EDUCATION.

# **AN ANALYSIS OF THE WELDING OCCUPATION**

**Developed By**

**Alex L. Pucci  
Vocational Welding Instructor  
Normandy High School  
Parma, Ohio**

**George F. Reichel  
Vocational Welding Instructor  
Max S. Hayes Vocational High School  
Cleveland, Ohio**

**Occupational Analysis  
E.P.D.A. Sub Project 73402  
June 1, 1973 to December 30, 1974  
Director: Tom L. Hindes  
Coordinator: William L. Ashley**

**The Instructional Materials Laboratory  
Trade and Industrial Education  
The Ohio State University**

3

"The activity which is the subject of this report was supported in whole or in part by the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred."

# TABLE OF CONTENTS

Foreword .....	v
Preface .....	vii
Acknowledgment .....	ix
Job Description.....	xi
Duties	
I. Oxy/Actylene Welding.....	1
II. Electric Arc Welding .....	27
III. Tungsten Inert-Gas Arc Welding .....	43
IV. Metallic Inert-Gas Arc Welding.....	59
Abbreviations .....	69
Eye Protection.....	71
Index: Safe Practices in Welding .....	73

5

## FOREWORD

The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one involved the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of conducting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis included a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills and mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures, as well as identifying specific supporting skills and knowledge in the academic subject areas.

## PREFACE

The information compiled in this document is an analysis of the required skills used in the performance of duties and tasks by the average welder. It includes the basic manipulative skills and technical information in the following four areas: oxy/acetylene, electric arc, tungsten inert-gas arc, and metallic inert-gas arc welding.

7

## ACKNOWLEDGMENT

We wish to acknowledge the valuable assistance rendered by the following subject matter specialists. They provided input to the vocational instructors in identifying related skills and concepts of each respective subject matter area and served as training assistants in the analysis process during the two-week workshops.

Rollin M. Barber, Psychology  
The Ohio State University  
Columbus, Ohio

Glenn Mann, Communications  
Columbus, Ohio

Jodi Beittel, Communications  
Columbus, Ohio

Jerry McDonald, Physical Sciences  
Columbus Technical Institute  
Reynoldsburg, Ohio

Diana L. Buckeye, Mathematics  
University of Michigan  
Avon Lake, Ohio

Colleen Osinski, Psychology  
Columbus Technical Institute  
Columbus, Ohio

Rick Fien, Chemistry  
The Ohio State University  
Beechwood, Ohio

David Porteous, Communications  
University of Connecticut  
Colchester, Connecticut

N. S. Gidwani, Chemistry  
Columbus Technical Institute  
Columbus, Ohio

James A. Sherlock, Communications  
Columbus Technical Institute  
Columbus, Ohio

Bruce A. Hull, Biology  
The Ohio State University  
Columbus, Ohio

Jim VanArsdall, Mathematics  
Worthington High School  
Worthington, Ohio

Donald L. Hyatt, Physics  
Worthington High School  
Worthington, Ohio

Lillian Yontz, Biology  
The Ohio State University  
Caldwell, Ohio



Acknowledgment is extended to the following I.M.L. staff members for their role in conducting the workshops; editing, revising, proofing and typing the analyses.

Faith Justice	Research Associate
Sheila Nelson	Administrative Assistant
Marsha Opritza	Editorial Consultant
Rita Buccilla	Typist
Carol Fausnaugh	Typist
Mindy Fausnaugh	Typist
Rita Hastings	Typist
Carol Hicks	Typist
Sue Holsinger	Typist
Barbara Hughes	Typist
Carol Marvin	Typist
Kathy Roediger	Typist

## **JOB DESCRIPTION**

A welder selects equipment, plans layout and welding procedure while applying knowledge of basic measurement skills and concepts, and the welding characteristics and physical properties of metals; sets up equipment and welds parts using arc or gas welding equipment; repairs products by dismantling, straightening, reshaping, and re-assembling them using cutting torch, straightening equipment and proper hand tools.

A welder also secures parts in position for welding by clamping, tack welding, or bolting; fits and welds components which have been fabricated, cast, or forged to assemble structural forms according to blueprints; performs welding operations in the flat, horizontal, vertical and overhead positions, utilizing all types of joint design.

10

xi

## **DUTY I. OXY/ACETYLENE WELDING**

- A. Set up and test equipment
- B. Oxy/acetyl weld mild steel
- C. Oxy/acetyl weld pipe
- D. Oxy/acetyl weld cast-iron
- E. Braze mild steel
- F. Braze cast-iron
- G. Silver Braze stainless steel
- H. Silver braze copper alloys
- I. Cut using oxy/acetylene
- J. Form and bend
- K. Hardface
- L. Soft solder

11

## (TASK STATEMENT) I-A SET UP AND TEST OXY-ACETYLENE WELDING EQUIPMENT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>Oxygen and Acetylene Supply Oxygen Regulator Acetylene Regulator Oxygen hose with fittings Acetylene hose with fittings Oxyacetylene Torch Oxyacetylene Torch Tips Leak testing fluids S. T. as required</p>	<p>Attach Oxygen Regulator to Oxygen supply Attach Acetylene Regulator to Acetylene supply Attach Oxygen and Acetylene hoses to respective supply Attach torch Test according to safety procedure</p>	<p>Refer to Index under Safe Practice: X—Safety Precautions for Hand Tools—[Items 1 thru 10] XIX—Oxy-Acetylene Welding—[Items 1 thru 35]</p>
<p><b><u>DECISIONS</u></b></p> <p>Attach Oxygen Regulator to Oxygen supply Attach Acetylene Regulator to Acetylene supply Attach hoses to respective supplies Attach torch to respective supplies Appraise results by visual inspection</p>	<p><b><u>CUES</u></b></p> <p>Type of gas-pressure required Standard colors and fittings Job requirement Job requirement Condition of fittings</p>	<p><b><u>ERRORS</u></b></p> <p>Explosive possibilities Explosive possibilities Explosive possibilities Explosive possibilities Damaged fittings-leaks</p>

SCIENCE	MATH — NUMBER SYSTEMS
<p>Fluids under pressure [Instability of gases under pressure] [Exceed maximum pressures of equipment] Relationship of forces to distortion in an elastic body. [Distort or break brass fittings]</p>	<p>Set of Real Numbers—[Positive rationals] Basic Measurement Skills and Concepts—Instruments [Read gauge-pounds per square inch, cubic feet per hour]</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p>Make oral requisitions for materials Read and interpret pressures on both gauges Read and follow written instruction for set-up Make written requisitions for materials needed Follow oral instructions Perform operation; appraise finished work</p>
KILLS/CONCEPTS	
<p>Terminology Logic, Gesturing, Usage Comprehension, Detail, Proposals, Description, Terminology Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>	

## (TASK STATEMENT) I-B OXY/ACETYL WELD MILD STEEL

14

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
Oxy/Acet Welding Equipment Materials: M.S. Material M.S. Filler Rod S.T. as required	Determine type weld Select filler rod size Select tip size Determine weld position Weld in accordance to proper procedure	Refer to Index under Safe Practice X--Safety Precautions for Hand Tools--[Items 1 thru 10] XIX--Oxy-Acetylene Welding--[Items 1 thru 35]
<b>DECISIONS</b>  Determine type weld Select filler rod Select tip size Determine position Appraise condition of finished weld by visual inspection	<b>CUES</b>  Specs, Job Requirement, Joint design Thickness of metal, bead size Thickness of metal, bead size Ease of application General appearance, uniformity, penetration, etc.	<b>ERRORS</b>  Will not meet job specifications Poor weld quality Poor weld quality Poor weld quality Poor weld quality

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage            Effect of heating and cooling on expansion of materials.            Fluids under pressure            Transfer of energy from one form to another.            Transfer of heat from one body to another            Arrangement of molecules, atoms and ions and the effect on structure and strength of materials.            [Different types carbon steels, physical characteristics]</p>	<p>Set of Real Numbers—Positive Rationals            [Fractions]            Fundamental Operations (Calculation)            Addition algorithm            Subtraction algorithm            Multiplication algorithm            Division algorithm            Order of operations            Basic Arithmetic Skills and Concepts    Ratio and proportion            [Weldment should be in direct relationship to the cross-section of parent metal]            Basic Measurement Skills and Concepts            Instruments [basic measurement]            Measurement, Geometric            Linear            Reading and interpreting tables, charts, and graphs            Scale drawings floor plans/blueprints</p>
COMMUNICATIONS	
PERFORMANCE MODES	SKILLS/CONCEPTS
<p>Speaking            Reading            Writing            Listening            Viewing            Touching</p>	<p>Terminology, Logic, Gestures, Usage            Comprehension, Detail, Proposals, Description,            Terminology, Instruction            Sketch, Description, Terminology, Logic, Usage            Discriminate facts, Logic Concentration, Note taking            Visual analysis, Logic, Description, Detail,            Recognition of symbols, Codes, etc            Size, Shape, Temperature</p>

## (TASK STATEMENT) I-C OXY/ACETYL WELD PIPE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
<p>Oxy/Acetylene Equipment</p> <p>Materials:</p> <ul style="list-style-type: none"><li>Steel Pipe</li><li>M. S. filler rod</li><li>Aligning fixture</li><li>S. T. as required</li></ul>	<p>Determine joint design</p> <p>Select filler rod</p> <p>Select tip size</p> <p>Determine weld position</p> <p>Align work</p> <p>Perform welding in accordance to proper procedure</p>	<p>Refer to Index under Safe Practice.</p> <p>X – Safety Precautions for Hand Tools – [Items 1 thru 10]</p> <p>XIX – Oxy-Acetylene Welding – [Items 1 thru 35]</p>
<p><b><u>DECISIONS</u></b></p> <p>Determine joint design</p> <p>Select filler</p> <p>Select tip size</p> <p>Determine weld position</p> <p>Appraise finish work by visual inspection</p>	<p><b><u>CUES</u></b></p> <p>Specifications, job requirements</p> <p>Metal thickness</p> <p>Amount heat required</p> <p>Ease of application</p> <p>Appearance, penetration, uniformity, etc.</p>	<p><b><u>ERRORS</u></b></p> <p>Will not meet job specifications</p> <p>Poor weld quality</p> <p>Poor weld quality</p> <p>Poor weld quality</p> <p>Poor weld quality</p>



SCIENCE	MATH — NUMBER SYSTEMS	
<p>Simple machines used to gain mechanical advantage. Effect of heating and cooling on expansion of materials. Transfer of heat from one body to another. Arrangement of molecules, atoms and ions and the effect on structure and strength of materials. [Types and Physical properties of Steel Pipe]</p>	<p>Set of Real Numbers—Positive Rationals [Fractions] Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions Basic Measurement Skills and Concepts Instruments [Basic measurements] Measurement, Geometric Linear Angle Measurement, Non-geometric Temperature Reading and interpreting tables, charts, and graphs Scale drawings floor plans/blueprints Basic Geometry Skills and Concepts Knowledge of geometric relationships Parallel Perpendicular Determination of area and circumference of circles Determination of area and perimeter of an ellipse. Determination of facts involving lines tangent to circles.</p>	
COMMUNICATIONS		
PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Writing Listening Viewing Touching	<p>Make oral requisitions for materials Interpret blueprint and written specifications Measure and layout pipe according to blueprint or sketch Make written requisition for materials needed Follow oral instructions if given Interpret blueprint and written specifications Examine finished product</p>	<p>Terminology, Logic, Gestures, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Terminology, Logic, Usage Discriminate Facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>

## (TASK STATEMENT) I-D OXY/ACETYL-WELD CAST IRON

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY - HAZARD
Oxy-Acetylene Welding Equipment S. T. as needed Cast Iron Filler Rod Cast Iron Material Flux	Determine type joint preparation Determine filler rod size Determine tip size Determine necessity of preheat/postheat Select flux Complete weld according to proper procedure	Refer to Index under Safe Practice X Safety Precautions for Hand Tools - [Items 1 thru 10] XIX - OXY-Acetylene Welding-- [Items 1 thru 35]
Determine joint preparation Determine filler rod size Determine tip size Determine necessity of preheat/postheat Determine flux Complete weld according to correct procedure.	Job requirement, condition of metal Determine by parent metal thickness Determine by parent metal thickness Weight and design of casting. A procedure necessity. Visual and specification.	<u>ERRORS</u>  Porosity, poor quality weld Poor quality, hard spots in weld Poor fusion, porosity, lack of penetration. Uneven expansion and contraction, possible cracking condition Poor fusion, porosity, hard spots in weld.

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage                      Effect of heating and cooling on expansion of materials.                      Fluids under pressure.                      Transfer of heat from one body to another                      Arrangement of molecules, atoms and ions and the effect on structure and strength of materials.                      Resistance of materials to change in shape.</p>	<p>Set of Real Numbers—Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions                      Basic Measurement Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Linear                      Reading and interpreting tables, charts, and graphs                      Scale drawings, floor plans/blueprints                      Basic Arithmetic Skills and Concepts                      Ratio and proportion                      [Amount of preheat needed in relation to the weight and design of casting]</p>
COMMUNICATIONS	
PERFORMANCE MODES	SKILLS/CONCEPTS
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description, Terminology Instruction                      Sketch Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc                      Size, Shape, Temperature</p>
EXAMPLES	
<p>Make oral requisition for materials                      Read preheat and postheat temperatures as noted in written or oral instructions                      Interpret blueprint and written specifications                      Make written requisitions for materials needed                      Follow oral instructions                      Examine finished weld</p>	

## (TASK STATEMENT) I-E BRAZE MILD STEEL

20

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
Oxy/Acetylene Equipment M. S. Material Bronze Filler Rod Proper Flux S. T. as required	Analyze job requirements Select filler rod size Select tip size Clean and prepare joint Determine weld position Apply proper flux and complete brazing operation in accordance to proper procedure	Refer to Index under Safe Practice X — Safety Precautions for Hand Tools — [Items 1 thru 10] XIX — OXY-Acetylene Welding — [Items 1 thru 35]
<u>DECISIONS</u>  Analyze job requirement Select rod size Select tip size Determine position Appraise finished joint by visual inspection	<u>CUES</u>  Job requirements Metal thickness/joint design Metal thickness/joint design Edge of application General appearance, uniformity of bead	<u>ERRORS</u>  Will not meet job requirement Porosity, Poor bond Porosity, poor bond Porosity, poor bond Porosity, poor bond—appearance

## ASK STATEMENT) I-E BRAZE MILD STEEL

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage.            Effect of heating and cooling on expansion of materials            Transfer of energy from one form to another            [gases and fluxes]            Arrangement of molecules, atoms and ions and the effect on            structure and strength of materials            Metallurgical reasons for bond</p>	<p>Set of Real Numbers Positive Rationals            Fundamental Operations (Calculation)            Addition algorithm            Subtraction algorithm            Multiplication algorithm            Division algorithm            Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.            Basic Measurements - [Basic Measurement]            Measurement: Geometric            Linear            Reading and interpreting tables, charts, and graphs            Scale drawings floor plans/blueprints            Basic Arithmetic Skills and Concepts            Ratio and proportion            [bond proportionate to parent metal]</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking            Reading            Writing            Listening            Viewing            Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials            Interpret blueprint and written specifications            Make written requisition for materials heeded            Follow oral instructions—if given            Examine work piece and finished product</p> <p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage            Comprehension, Detail, Proposals, Description,            Terminology, Instruction            Sketch, Description, Logic, Terminology, Usage            Discriminate facts, Logic, Concentration, Note taking            Visual analysis, Logic, Discrimination, Detail,            Recognition of symbols, Codes, etc.            Size, Shape, Temperature</p>

TOOLS, EQUIPMENT, MATERIALS, •OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>Oxy-Acet. Equipment S. T. as required Cast iron material Bronze filler rod Flux</p>	<p>Determine preparation needed Select filler rod size Select tip size Determine position Determine preheat/postheat Apply proper flux-complete brazing operation following proper procedures.</p>	<p>Refer to Index under Safe Practice X - Safety Precautions for Hand Tools-- [Items 1 thru 10] XIX - OXY-Acetylene Welding-- [Items 1 thru 35]</p>
<p><u>DECISIONS</u></p> <p>Determine preparation needed Select fill rod size Select tip size Determine position Determine preheat/postheat Appraise finished work</p>	<p><u>CUES</u></p> <p>Job requirement, joint design, condition of metal Job requirement, metal thickness, bead size Metal thickness Job requirement Job requirement Appearance, uniformity</p>	<p><u>ERRORS</u></p> <p>Porosity, poor adhesion Porosity, poor adhesion Poor adhesion, appearance Poor appearance Uneven expansion and contraction</p>

## ASK STATEMENT) I-F BRAZE CAST IRON

SCIENCE		MATH — NUMBER SYSTEMS	
<p>Simple machines used to gain mechanical advantage—[use of S.T.]</p> <p>Effect of heating and cooling on expansion of materials—[cracks]</p> <p>Fluids under pressure—[gas]</p> <p>Transfer of heat from one body to another—[metals]</p> <p>Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[weld and material]</p> <p>Resistance of materials to change in shape—[cast iron cannot be bent or shaped at any temperature]</p> <p>Metallurgical reasons for bond</p>	<p>Set of Real Numbers—Positive Rationals</p> <p>Fundamental Operations (Calculation)</p> <p>Addition algorithm</p> <p>Subtraction algorithm</p> <p>Multiplication algorithm</p> <p>Division algorithm</p> <p>Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.</p> <p>Basic Measurement Skills and Concepts</p> <p>Instruments—[Basic Measurement]</p> <p>Measurement: Geometric</p> <p>Linear</p> <p>Reading and interpreting tables, charts, and graphs</p> <p>Scale drawings: floor plans/blueprints</p>		
PERFORMANCE MODES		COMMUNICATIONS	
<p>Speaking</p> <p>Reading</p> <p>Writing</p> <p>Listening</p> <p>Viewing</p> <p>Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials</p> <p>Read preheat and postheat temperatures as noted in written or oral instructions</p> <p>Interpret blueprint and written specifications</p> <p>Make written requisitions for materials needed</p> <p>Follow oral instructions</p> <p>Appraise finished work</p>	<p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage</p> <p>Comprehension, Detail, Proposals, Description, Terminology, Instruction</p> <p>Sketch, Description, Logic, Terminology, Usage</p> <p>Discriminate facts, Logic, Concentration, Note taking</p> <p>Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.</p> <p>Size, Shape, Temperature</p>	

## (TASK STATEMENT) I-G SILVER BRAZE STAINLESS STEEL

24

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
Oxy/Acetylene Welding Equipment Material: Stainless Steel Silver Alloy filler wire Silver brazing flux S. T. as required	Determine joint design Select type and size of filler wire Select tip size Clean and prepare joint Determine position Apply proper flux complete work in accordance to proper procedure	Refer to index under Safe Practice X- Safety Precautions for Hand Tools--[Items 1 thru 10] XIX-- OXY-Acetylene Welding--[Items 1 thru 35]
<b>DECISIONS</b>  Determine joint design Select type/size filler Select tip size Determine position Appraise finished work by visual inspection	<b>CUES</b>  Job requirements Physical, chemical properties Amount of heat requirement Ease of application General appearance, porosity, uniformity	<b>ERRORS</b>  Will not meet job specifications Will not meet job specifications Poor bonding Poor bonding Excessive heat, breaks down physical properties of base metal



SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]                      Effect of heating and cooling on expansion of materials—[distortion]                      Transfer of energy from one form to another—[chemical reaction of fluxes]                      Transfer of heat from one body to another—[capillary action]                      Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[strength of bond]                      [Physical and chemical properties of Silver Alloys and brazing fluxes]                      [Types of stainless steel alloys]</p>	<p>Set of Real Numbers — Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions                      Basic Measurement Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Linear                      Reading and interpreting tables, charts, and graphs                      Scale drawings/floor plans/blueprints                      Basic Arithmetic Skills and Concepts                      [Bond Proportionate parent metal]</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisitions for materials                      Interpret blueprint and written specifications                      Make written requisitions for materials needed                      Follow oral instructions                      Perform operation, appraise finished work</p> <p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description,                      Terminology, Instruction                      Sketch, Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail,                      Recognition of symbols, Codes, etc.                      Size, Shape, Temperature</p>

## (TASK STATEMENT) I-H SILVER BRAZE COPPER ALLOYS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>Oxy-Acet. Equipment S. T. as required</p> <p>Copper alloy material Silver alloy filler wire Silver brazing flux</p>	<p>Determine joint design Determine preparation needed Select tip size Determine position Complete brazing operation following proper procedure</p>	<p>Refer to Index under Safe Practice X — Safety Precautions for Hand Tools — [Items 1 thru 10] XIX — OXY-Acetylene Welding — [Items 1 thru 35]</p>
<p><u>DECISIONS</u></p> <p>Determine joint design Determine preparation needed Select tip size Select filler wire size Determine position Appraise finished work</p>	<p><u>CUES</u></p> <p>Job requirement Job requirement Thickness of base metal Thickness of base metal Ease of application Appearance, specification</p>	<p><u>ERRORS</u></p> <p>Weakened weldment Porosity, poor adhesion Porosity, poor adhesion Material waste Poor quality and appearance</p>

SCIENCE

Simple machines used to gain mechanical advantage—[use of Standard tools]  
 Effect of heating and cooling on expansion of materials—[size, shape]  
 Fluids under pressure—[gas]  
 Transfer of heat from one body to another—[rapid transmission]  
 Arrangement of molecules, atoms and ions and the effect on  
 structure and strength of materials—[weld and material]  
 [Different silver brazing materials available]

MATH — NUMBER SYSTEMS

Set of Real Numbers—Positive Rationals  
 Fundamental Operations (Calculation)  
 Addition algorithm  
 Subtraction algorithm  
 Multiplication algorithm  
 Division algorithm  
 Order of operations, i.e. Use of parentheses in simplifying arithmetic expressions.  
 Basic Measurements—[Basic Measurement]  
 Measurement: Geometric  
 Linear  
 Reading and interpreting tables, charts, and graphs  
 Scale drawings/floor plans/blueprints

COMMUNICATIONS

PERFORMANCE MODES

Speaking  
 Reading  
 Writing  
 Listening  
 Viewing  
 Touching

EXAMPLES

Make oral requisitions for materials  
 Interpret blueprint and written specifications  
 Make written requisitions for materials needed.  
 Follow oral instructions  
 Appraise job

SKILLS/CONCEPTS

Terminology, Logic, Gesture, Usage  
 Comprehension, Detail, Proposals, Description,  
 Terminology, Instruction  
 Sketch, Description, Logic, Terminology, Usage  
 Discriminate facts, Logic, Concentration, Note taking  
 Visual analysis, Logic, Discrimination, Detail,  
 Recognition of symbols, Codes, etc.  
 Size, Shape, Temperature

## (TASK STATEMENT) I-I CUT USING OXY/ACETYLENE

28

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
Oxy/Acetylene Equipment Cutting Torch Assembly M. S. Material S. T. as required	Determine job requirements Layout material using center punch or scribe Select tip size Select proper gas pressures Preheat to start cut Open oxygen torch cutting valve and proceed to complete cut following layout	Refer to Index under Safe Practice X — Safety Precautions for Hand Tools — [Items 1 thru 10] ✓ XIX — OXY-Acetylene Welding — [Items 1 thru 35]
<u>DECISIONS</u>  Job requirements Select tip size Select gas pressures Evaluate finished cut visually	<u>CUES</u>  Job requirements Thickness of metal to be cut Thickness of metal to be cut Cut should have uniform kerf, square edge.	<u>ERRORS</u>  Improper cut Improper cut Improper cut Excessive slag, rough edge, kerf too wide

28

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]                      Effect of heating and cooling on expansion of materials—[distortion]                      Fluids under pressure—[awareness of gases under pressure]</p>	<p>Set of Real Numbers—Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of Operations, i.e., Use of parentheses in simplifying arithmetic expressions.                      Basic Measurements Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Angle                      Measurement: Non-geometric                      Temperature                      Reading and interpreting tables, charts, and graphs                      Maps                      Basic Geometry Skills and Concepts                      Knowledge of geometric relationships                      Parallel                      Perpendicular                      Determination of area and circumference of circles.                      Determination of area and perimeter of an ellipse.                      Determination of facts involving lines tangent to circles.</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p>Make oral requisition for materials                      Interpret blueprint and written specifications                      Make written requisition for materials needed                      Lay-out job according to blueprint, sketch, or instruction                      Set pressures according to manufacturers' chart.</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description, Terminology, Instruction                      Sketch, Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail,                      Recognition of symbols, Codes, etc.                      Size, Shape, Temperature</p>	

## (TASK STATEMENT) I-J FORM AND BEND

30

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
Oxy/Acetylene Equipment Material to be formed or shaped Jigs and/or Fixtures required S. T. as required	Determine job requirements Set-up Jig and/or fixture required Select heating torch and tip size Heat material until plastic enough to be formed to desired shape Complete operation to job requirements	Refer to Index under Safe Practice X — Safety Precautions for Hand Tools — [Items 1 thru 10] XIX — OXY-Acetylene Welding — [Items 1 thru 35]
<b>DECISIONS</b>  Determine job requirements Set-up Jig and/or fixture Evaluate finished product by visual inspection	<b>CUES</b>  Job requirements Ease of performance Job requirements	<b>ERRORS</b>  Will not meet job specifications Will not meet job specifications Undesired physical properties

TASK STATEMENT)		MATH — NUMBER SYSTEMS	
SCIENCE		Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions Basic Measurement Skills and Concepts Instruments —[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings floor plans/blueprints	
PERFORMANCE MODES		COMMUNICATIONS	
Speaking Reading Writing Listening Viewing Touching	EXAMPLES	SKILLS/CONCEPTS	
	Make oral requisition for materials Layout job according to blueprint, sketch, or oral instruction Interpret blueprint and written specifications Make written requisition for materials needed Follow oral instructions Perform operation, appraisal finished work	Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc Size, Shape, Temperature	

## (TASK STATEMENT) I-K HARDFACE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
Oxy/Acet. equipment S T. as required Grinder Steel or Steel Alloy material Hardfacing filler rod	Determine joint design Determine preparation needed Select tip size Select filler rod size and type Determine position Complete hardfacing operation—following proper procedure	Refer to Index under Safe Practice X Safety Precautions for Hand Tool—[Items 1 thru 10] XIX OXY-Acetylene Welding—[Items 1 thru 35]
Determine joint design Determine preparation needed Select tip size Select filler rod size and type Determine position Appraise finished work	Job requirements Condition of metal, job requirement Thickness of base metal Results desired Ease of application Appearance and specifications	<u>ERRORS</u>  Material waste Poor adhesion, porosity Poor adhesion. Dilution of bead Wrong physical properties Poor appearance—too soft



## ASK STATEMENT) I-K HARDFACE

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]            Effect of heating and cooling on expansion of materials—[cracks]            Fluids under pressure—[instability of gases]            Transfer of heat from one body to another—[effect of adjacent areas]            Arrangement of molecules, atoms and ions and the effect on structure and strength of materials            Resistance of materials to change in shape—[rigid and hard material]            [the metallurgy of hardfacing materials]</p>	<p>Set of Real Numbers—Positive Rationals            Fundamental Operations (Calculation)            Addition algorithm            Subtraction algorithm            Multiplication algorithm            Division algorithm            Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions            Basic Measurement Skills and Concepts            Instruments—[Basic Measurement]            Measurement: Geometric            Linear            Reading and interpreting tables, charts, and graphs            Scale drawings/floor plans/blueprints            Basic Arithmetic Skills and Concepts—Ratio and proportion            [ratio of hardness of application to hardness of parent metal]</p>
COMMUNICATIONS	
<p><u>PERFORMANCE MODES</u></p> <p>Speaking            Reading            Writing            Listening            Viewing            Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials            Interpret blueprint and written specifications            Make written requisition for materials needed            Follow oral instructions            Appraise work</p>
	<p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage            Comprehension, Detail, Proposals, Description, Terminology, Instruction            Sketch, Description, Logic, Terminology, Usage            Discriminate facts, Logic, Concentration, Note taking            Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.            Size, Shape, Temperature</p>

## (TASK STATEMENT) I-L SOFT SOLDER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>Oxy Acetylene Equipment Material to be Soft Soldered fixtures, chill block etc. as required Solder material as required Proper flux S. T. as required</p>	<p>Determine job requirements Determine procedure Select proper solder material Select proper flux Select tip size Position work to protect components from heat Complete operation following proper procedure</p>	<p>Refer to Index under Safe Practice X Safety Precautions for Hand Tools [Items 1 thru 10] XIX OXY-Acetylene Welding [Items 1 thru 35]</p>
<p><u>DECISIONS</u>  Determine job requirement Determine procedure Select soldering material Select flux Evaluate finished operation by visual inspection</p>	<p><u>CUES</u>  Job requirements Ease of application Type of metal being soldered Type of metal being soldered Amount of heat required General appearance, complete bond, neat and clean</p>	<p><u>ERRORS</u>  Will not meet job requirements Poor bond</p>

## ASK STATEMENT) I-L SOFT SOLDER

SCIENCE	MATH — NUMBER SYSTEMS	
<p>Simple machines used to gain mechanical advantage—[use of Standard tools] Effect of heating and cooling on expansion of materials—[finished product] Transfer of energy from one form to another—[chemical reaction fluxes] Transfer of heat from one body to another—[effect adjacent material] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[finished bond] [Physical &amp; chemical properties of soldering alloys and fluxes]</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions. Basic Measurement Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings/floor plans/blueprints Basic Arithmetic Skills and Concepts—Ratio and proportion Basic Geometry Skills and Concepts—Congruence</p>	
COMMUNICATIONS		
PERFORMANCE MODES	EXAMPLES,	SKILLS/CONCEPTS
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p>Make oral requisition for materials Interpret blueprint and written specifications Make written requisition for materials needed Follow oral instructions Appraise work</p>	<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>

## **DUTY II. ELECTRIC ARC WELDING**

- A. Set up equipment for electric arc welding**
- B. Arc weld mild steel**
- C. Arc weld pipe**
- D. Arc weld stainless steel**
- E. Arc weld cast iron**
- F. Hardface**
- G. Cut metals**

36

# II-A SET UP AND ADJUST EQUIPMENT FOR ELECTRIC ARC WELDING

(TASK STATEMENT)

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

AC-DC Arc Welding equipment,  
Cables and fittings  
S. T. as required

PERFORMANCE KNOWLEDGE

Determine operation requirements  
Connect correct power lead connection  
Connect correct electrode and ground cable connections  
Inspect current and polarity controls  
Inspect performance of welding machine

SAFETY — HAZARD

\* Refer to Index under Safe Practice:  
XVIII — Electric Arc Welding — [Items 1 thru 28]

## DECISIONS

Determine amount of set-up necessary  
Determine correct power source and leads  
Determine correct electrode and ground cable connections  
Determine correct current and polarity settings  
Evaluate completed set-up

## CUES

Operation requirement  
Operation requirement  
Operation requirement  
Electrode to be used  
Results

## ERRORS

Incomplete set-up  
Machine will not function properly  
Poor performance  
Poor performance

# II-A SET UP AND ADJUST EQUIPMENT FOR ELECTRIC TASK STATEMENT) ARC WELDING

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]            Transfer of energy from one form to another—[electrical energy to heat]            Resistance of materials to flow of electrical current—[correct cable size]</p>	<p>Set of Real Numbers—Positive Rationals            Fundamental Operations (Calculation)            Addition algorithm            Subtraction algorithm            Multiplication algorithm            Division algorithm            Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.            Basic Measurement Skills and Concepts            Instruments—[Basic Measurement]            Measurement: Geometric            Linear            Reading and interpreting tables, charts, and graphs            Scale drawings/floor plans/blueprints</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking            Reading            Writing            Listening            Viewing            Touching</p>	<p><b>SKILLS/CONCEPTS</b>            Terminology, Logic, Gesture, Usage            Comprehension, Detail, Proposals, Description,            Terminology, Instruction            Sketch, Description, Logic, Terminology, Usage            Discriminate facts, Logic, Concentration, Note taking            Visual analysis, Logic, Discrimination, Detail,            Recognition of symbols, Codes, etc.            Size, Shape, Temperature</p>

## (TASK STATEMENT) II-B ARC WELD MILD STEEL

39

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
<p>AC DC Arc Welding equipment M. S. Material Welding Electrodes S. T. as required</p>	<p>Determine joint design Select electrode type, size Determine weld position Select polarity Adjust current Strike Arc and complete weld in accordance to proper procedure</p>	<p>Refer to Index under Safe Practice: XVIII Electric Arc Welding [Items 1 thru 28]</p>
<u>DECISIONS</u>	<u>CUES</u>	<u>ERRORS</u>
<p>Determine joint design Select electrode size Determine weld position Select polarity Adjust amperage Evaluate finished weld by visual inspection</p>	<p>Job requirements Physical &amp; chemistry, current requirements Ease of application Electrode requirement For penetration Good appearance, penetration informity</p>	<p>Will not meet job specifications Poor weld quality Difficult to perform Poor weld quality Poor weld quality Impurities, poor penetration, etc.</p>

## ASK STATEMENT) II-B ARC WELD MILD STEEL

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]            Effect of heating and cooling on expansion of materials—[control distortion]            Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[weld]</p>	<p>Set of Real Numbers—Positive Rationals            Fundamental Operations (Calculation)            Addition algorithm            Subtraction algorithm            Multiplication algorithm            Division algorithm            Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.            Basic Measurement Skills and Concepts            Instruments—[Basic Measurement]            Measurement: Geometric            Linear            Reading and interpreting tables, charts, and graphs            Scale drawings/floor plans/blueprints            Basic Arithmetic Skills and Concepts—Ratio and proportion            [weld proportionate to parent metal]</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking            Reading            Writing            Listening            Viewing            Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials            Interpret blueprint and written specifications. Seek information.            Make written requisitions for materials needed            Follow oral instructions            Appraise work</p> <p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage            Comprehension, Detail, Proposals, Description, Terminology, Instruction            Sketch, Description, Logic, Terminology, Usage            Discriminate facts, Logic, Concentration, Note taking            Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.            Size, Shape, Temperature</p>



## (TASK STATEMENT) II-C ARC WELD STEEL PIPE

A1

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<ul style="list-style-type: none"><li>• AC DC Arc Welding equipment</li><li>S. T. as required</li><li>Alignment fixture</li><li>Steel Pipe</li><li>Electrodes</li></ul>	<p>Determine joint design Determine alignment procedure Determine electrode size and type Determine position Determine polarity setting Adjust current Complete weld according to proper procedure</p>	<p>Refer to Index under Safe Practice XVIII Electric Arc Welding - [Items 1 thru 28]</p>
<p><u>DECISIONS</u></p> <p>Determine joint design Determine alignment procedure Determine electrode size and type Determine position Determine polarity setting Adjust current Appraise finished work</p>	<p><u>CUES</u></p> <p>Job requirements, specifications Job requirements, specifications Job requirements, specifications Ease of application According to electrode type Job requirement Visual appearance, specifications</p>	<p><u>ERRORS</u></p> <p>Lack of fusion and penetration Misalignment of weldment Poor quality of weld Poor quality of weld, appearance Poor quality of weld, appearance Poor quality of weld, appearance</p>

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools] Effect of heating and cooling on expansion of materials—[change in material size] Magnetic fields of force—[electric characteristics] Transfer of energy from one form to another—[Electrical energy to heat] Transfer of heat from one body to another—[adjacent areas] Resistance of materials to flow of electrical current—[cable size, electrode size] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of Operations, i.e., Use of parentheses in simplifying arithmetic expressions. Basic Measurements Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Angle Measurement: Non-geometric Temperature Reading and interpreting tables, charts, and graphs Basic Geometry Skills and Concepts Knowledge of geometric relationships Parallel Perpendicular Determination of area and circumference of circles. Determination of area and perimeter of an ellipse. Determination of facts involving lines tangent to circles.</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
Speaking Reading Writing Listening Viewing Touching	<p>Make oral requisitions for materials Interpret blueprint and written specifications Measure and lay-out pipe according to blueprint Make written requisitions for materials needed Follow oral instructions Appraise work</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc Size, Shape, Temperature</p>	

## TASK STATEMENT) II-D ARC WELD STAINLESS STEEL

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

AC/DC Arc Welding equipment  
Stainless Steel material  
Stainless Steel electrodes

S. T. as required

## PERFORMANCE KNOWLEDGE

Determine joint design  
Select electrode type/size  
Determine welding position  
Select polarity  
Adjust current  
Set up work, proceed with weld.  
Technique used consistent with proper procedure

## SAFETY — HAZARD

Refer to Index under Safe Practice:  
XVIII — Electric Arc Welding—[Items 1 thru 18]

DECISIONS

Determine joint design  
Select electrode type/size  
Determine weld position  
Select polarity  
Adjust current  
Set up work  
Appraise finished weld by visual inspection

CUES

Job requirement  
Physical & chemical property  
Ease of application  
Electrode requirement  
For proper penetration etc.  
Ease of operation  
Appearance, uniformity penetration

ERRORS

Does not meet requirement  
Does not meet requirement  
Job difficult to perform  
Poor weld quality  
Poor weld quality  
Job difficult to perform  
Impurities in weld, poor penetration, etc.

## ASK STATEMENT) II-D ARC WELD STAINLESS STEEL

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[standard tools] Effect of heating and cooling on expansion of materials—[control distortion] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [physical and chemical characteristics of electrodes, electrode coatings and their function]</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions Basic Measurement Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings/floor plans/blueprints</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p><u>SKILLS/CONCEPTS</u>  Terminology, Logic, Gesture, Usage Comprehension, Detail; Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>

# TASK STATEMENT) II-E ARC WELD CAST IRON

## TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

AC DC Arc Welding equipment  
S T as required  
Grinder  
Cast iron material  
Electrodes

## PERFORMANCE KNOWLEDGE

Determine joint design  
Determine preparation needed  
Select electrode--size and type  
Determine position  
Determine polarity setting  
Adjust current  
Determine preheat/postheat needed  
Complete weld, using proper procedure

## SAFETY -- HAZARD

Refer to Index under Safe Practice  
XVIII Electric Arc Welding [Items 1 thru 28]

## DECISIONS

Determine joint design  
Determine preparation needed  
Select electrode--size and type  
Determine position  
Determine polarity setting  
Adjust current  
Determine preheat/postheat needed  
Appraise finished work

## CUES

Job requirement  
Condition of metal--dirt, rust, etc.  
Job requirement  
Job requirement  
Electrode requirement  
Job requirement  
Job requirement  
Visual appearance and specifications

## ERRORS

Material waste  
Porosity--poor quality  
Wrong physical properties  
Poor bead shape  
Poor quality of weld metal  
Poor quality of weld metal  
Possible cracking

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[standard tools]                      Effect of heating and cooling on expansion of materials—[cracks]                      Magnetic fields of force—[behavior of electric arc effected]                      Transfer of energy from one form to another—[electric energy to heat]                      Transfer of heat from one body to another—[adjacent areas]                      Resistance of materials to flow of electrical current—[cable size, electrode size]                      Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[weld]                      Resistance of materials to change in shape—[cast iron cannot be bent or shaped]</p>	<p>Set of Real Numbers—Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions                      Basic Measurement Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Linear                      Reading and interpreting tables, charts, and graphs                      Scale drawings/floor plans/blueprints                      Basic Arithmetic Skills and Concepts—Ratio and proportion                      [ratio of expansion and contraction to heating and cooling.]</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p>Make oral requisitions for materials                      Read preheat and postheat temperatures as noted in written or oral instructions                      Interpret blueprint and written specifications                      Make written requisitions for materials needed                      Follow oral instructions                      Appraise work</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description, Terminology, Instruction                      Sketch, Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.                      Size, Shape, Temperature</p>	

## TASK STATEMENT) II-F HARDFACE

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

AC DC Arc Welding equipment  
S T as required  
Grinder  
Steel or steel alloy material  
Hardfacing electrodes

## PERFORMANCE KNOWLEDGE

Determine joint design  
Determine preparation needed  
Select electrode—size and type  
Determine position  
Determine polarity setting  
Adjust current  
Complete hardfacing operation according to procedure

## SAFETY — HAZARD

Refer to Index under Safe Practice  
XVIII Electric Arc Welding [Items 1 thru 28]

DECISIONS

Determine joint design  
Determine preparations needed  
Select electrode—size and type  
Determine position  
Determine polarity setting  
Adjust current  
Appraise finished work

CUES

Job requirement  
Job requirement  
Electrode used according to specifications  
Ease of application  
Determined by electrode type  
Job requirement  
Visual/appearance and specification

ERRORS

Material waste  
Poor quality—poor adhesion  
Material waste—poor quality  
Poor shape of bead  
Poor quality  
Poor adhesion effects physical properties  
Poor appearance—too soft

## SCIENCE

Simple machines used to gain mechanical advantage—[use of standard tools]  
 Effect of heating and cooling on expansion of materials—[cracks]  
 Transfer of heat from one body to another—[adjacent areas]  
 Arrangement of molecules, atoms and ions and the effect on  
 structure and strength of materials—[weld]  
 Resistance of materials to change in shape—[rigid and hard]

## MATH — NUMBER SYSTEMS

Set of Real Numbers—Positive Rationals  
 Fundamental Operations (Calculation)  
 Addition algorithm  
 Subtraction algorithm  
 Multiplication algorithm  
 Division algorithm  
 Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions  
 Basic Measurement Skills and Concepts  
 Instruments—[Basic Measurement]  
 Measurement: Geometric  
 Linear  
 Reading and interpreting tables, charts, and graphs  
 Scale drawings/floor plans/blueprints  
 Basic Arithmetic Skills and Concepts—Ratio and proportion  
 [comparison of cost of hardfacing to cost of new part]

## COMMUNICATIONS

PERFORMANCE MODES

Speaking  
 Reading  
 Writing  
 Listening  
 Viewing  
 Touching

EXAMPLES

Make oral requisitions for materials  
 Interpret blueprint and written specifications  
 Make written requisitions for materials needed  
 Follow oral instructions  
 Appraise work

SKILLS/CONCEPTS

Terminology, Logic, Gesture, Usage  
 Comprehension, Detail, Proposals, Description,  
 Terminology, Instruction  
 Sketch, Description, Logic, Terminology, Usage  
 Discriminate facts, Logic, Concentration, Note taking  
 Visual analysis, Logic, Discrimination, Detail,  
 Recognition of symbols, Codes, etc  
 Size, Shape, Temperature



## (TASK STATEMENT) II-G CUT METALS

49

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

AC DC Arc Welding equipment  
Metal to be cut  
Cutting Electrodes  
Standard tools as required

## PERFORMANCE KNOWLEDGE

Determine job requirements  
Select electrode type size  
Layout metal using proper marking tool  
Adjust current  
Strike arc, complete cutting operation  
according to proper procedure

## SAFETY — HAZARD

Refer to Index under, Safe Practice  
XVIII Electric Arc Welding [Items 1 thru 28]

DECISIONS

Determine job requirements  
Select electrode type size  
Adjust current  
Evaluate finished  
cut by visual inspection

CUES

Job requirements  
Type and thickness metal to be cut  
Type and thickness metal to be cut  
Uniformity, proper dimension, neat, etc.

ERRORS

Will not meet job requirements  
Poor, erratic, incomplete cut  
Poor, erratic, incomplete cut  
Poor, erratic, incomplete cut

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use standard tools]                      Effect of heating and cooling on expansion of materials—[Distortion]                      Transfer to energy from one form to another—[electrical energy converted to heat]                      Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[heat effected zone]                      [Physical and chemical characteristics of electrodes, electrode coatings and their function]</p>	<p>Set of Real Numbers—Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions                      Basic Measurement Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Linear                      Reading and interpreting tables, charts, and graphs                      Scale drawings/floor plans/blueprints</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p>Make oral requisition for materials                      Interpret blueprint and written specifications                      Lay-out job according to blueprint, sketch, or written instructions                      Make written requisitions for materials needed                      Follow oral instructions                      Appraise work</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description, Terminology, Instruction                      Sketch, Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.                      Size, Shape, Temperature</p>	

### **DUTY III. TUNGSTEN INERT-GAS ARC WELDING**

- A. Set up Tungsten Inert-Gas welding equipment**
- B. TIG weld mild steel**
- C. TIG weld pipe**
- D. TIG weld stainless steel**
- E. TIG weld aluminum**
- F. TIG weld cast iron**
- G. Hardface**

51

## TASK STATEMENT) III-A SET UP TUNGSTEN-INERT-GAS WELDING EQUIPMENT

52

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

AC/DC Arc Welding Equipment with Hi-frequency unit.  
Cables and fittings  
TIG Torch assembly  
Tungsten electrodes  
Inert gas supply  
S. T. as required

## SAFETY -- HAZARD

Refer to Index under Safe Practice:  
XVIII-- Electric Arc Welding--[Items 1 thru 28]

## PERFORMANCE KNOWLEDGE

Determine operation requirement  
Determine power lead connection  
Determine electrode and ground cable connection  
Determine water supply connections  
Determine flow meter connections  
Determine torch assembly connections  
Inspect all controls  
Evaluate completed set-up.

DECISIONS

Determine amount of set-up necessary  
Correct placement of power lead  
Correct electrode and ground cable connections  
Correct water supply connection  
Correct flow meter connections  
Correct torch assembly connection  
Correct setting and function of controls  
Evaluate completed set-up

CUES

Job requirements  
Connect according to directions  
Connect according to directions  
Ample supply  
Set-up requirement  
Set-up requirement  
Set-up requirement  
All phases working

ERRORS

Wrong rotation  
Wrong polarity possible  
Overheating  
Leaks weld contamination  
Leaks weld contamination  
Leaks weld contamination

SCIENCE	MATH — NUMBER SYSTEMS
<p>Indestructibility of energy and matter—[non-consumable electrode]  Simple machines used to gain mechanical advantage—[use of Standard Tools]  Effect of heating and cooling on state of matter—[changes possible physical metallurgy]  Transfer of heat from one body to another—[Heat treating]  Resistance of materials to flow of electrical current—[cable size, Electrode size]  Relationship of force to distortion in an elastic body—[Forging and Shaping]  Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[Welds and Metals]  Fluid's under pressure—[inert gases and their function]  Physical characteristics of inert gases and their function</p>	<p>Set of Real Numbers—Positive Rationals  Basic Measurement Skills and Concepts—Instruments  [read gauge pounds per square inch, cubic feet per hour]</p>
COMMUNICATIONS	
PERFORMANCE MODES	SKILLS/CONCEPTS
<p>Speaking  Reading  Writing  Listening  Viewing  Touching</p>	<p>Terminology, Logic, Gesture, Usage  Comprehension, Detail, Proposals, Description, Terminology, Instruction  Sketch, Description, Logic, Terminology, Usage  Discriminate facts, Logic, Concentration, Note taking  Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.  Size, Shape, Temperature</p>
EXAMPLES	
<p>Make oral requisitions for materials  Read and follow written instructions for set-up  Make written requisitions for materials needed  Follow oral instructions  Appraise work</p>	

## (TASK STATEMENT) III-B TIG WELD MILD STEEL

54

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
AC/DC Arc Welding Equipment — Hi-frequency capability Flow Meter Regulator TIG Welding Torch Tungsten Electrodes Inert Gas Supply M. S. Material M. S. Filler Rod S. T. as required	Determine joint design Select electrode size Determine weld position Select polarity Adjust current Adjust inert-gas flow Set and adjust hi-frequency Set up work, complete weld according to proper procedure	Refer to Index under Safe Practice: XVIII — Electric Arc Welding [Items 1 thru 28]
<u>DECISIONS</u>  Determine joint design Select electrode size Determine position Adjust current Adjust gas flow Set and adjust hi-frequency Appraise finished work by visual inspection	<u>CUES</u>  Job requirement or specs Current requirements Ease of application Proper penetration Proper shielding Spark intensity, mode, etc Appearance, Penetration, Uniformity, etc.	<u>ERRORS</u>  Does not meet requirement Improper Arc characteristics Poor weld quality Poor weld quality Poor weld quality Electrode contamination Porosity, penetration, cracks, etc.

54

SCIENCE	MATH — NUMBER SYSTEMS	
<p>Simple machines used to gain mechanical advantage. —[use of standard tools] Effect of heating and cooling on expansion of materials —[Control distrotron] Transfer of heat from one body to another —[water cooled torch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials —[strength of weld] [Physical characteristics of inert gases and their function] [Different types of Tungsten Electrodes and their use Hi-frequency and its function]</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions Basic Measurement Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings/ floor plans/blueprints Basic Arithmetic Skills and Concepts—Ratio and proportion [Weldment proportional to parent metal]</p>	
COMMUNICATIONS		
PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Writing Listening Viewing Touching	<p>Make oral requisitions for materials Interpret blueprint or written specifications Make written requisitions for materials needed Follow oral instructions Appraise work</p>	<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>

# (TASK STATEMENT) III-C TIG WELD PIPE

## TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

AC/DC Arc Welding equipment with High-frequency unit.  
TIG Torch Assembly  
Tungsten Electrode  
Inert gas supply  
Aligning fixture  
Pipe  
Filler rod  
St. T. as required

## SAFETY — HAZARD

Refer to Index under Safe Practice;  
XVIII Electric Arc Welding (Items 1 thru 28)

## PERFORMANCE KNOWLEDGE

Determine joint design  
Determine alignment procedure  
Determine electrode size and type  
Determine filler rod size and type  
Determine position  
Determine current setting  
Determine polarity setting  
Determine gas flow  
Complete weld according to proper procedure

## DECISIONS

Determine joint design  
Determine alignment procedure  
Select electrode size and type  
Select filler rod size and type  
Determine position  
Select current setting  
Select polarity setting  
Set gas flow  
Appraise finished work

## CUES

Job requirement or specification  
Job requirement or specification  
According to parent metal  
More efficient ease of application  
Job requirement-specification  
Job requirement-specification  
Job requirement-specification  
Visual appearance and specifications

## ERRORS

Lack of fusion and penetration  
Misalignment of weldment  
Poor quality of weld  
Poor quality of weld  
Poor quality of weld  
Poor quality of weld  
Poor quality of weld  
Weld contamination



## SCIENCE

Simple machines used to gain mechanical advantage—[use of standard tools]  
 Effect of heating and cooling on expansion of materials—[change in material size]  
 Transfer of energy from one form to another—[effect on adjacent areas]  
 Resistance of heat from one body to another—[effect on adjacent areas]  
 Resistance of materials to flow of electrical current—[cable size, electrode size]  
 Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[strength of weld]  
 [Physical characteristics of inert gases and their function]  
 [Tungsten electrodes—types High-frequency and its functions]

## MATH — NUMBER SYSTEMS

Set of Real Numbers—Positive Rationals  
 Fundamental Operations (Calculation)  
 Addition algorithm  
 Subtraction algorithm  
 Multiplication algorithm  
 Division algorithm  
 Order of Operations, i.e., Use of parentheses in simplifying arithmetic expressions  
 Basic Measurements Skills and Concepts  
 Instruments—[Basic Measurement]  
 Measurement: Geometric  
 Angle  
 Measurement: Non-geometric  
 Temperature  
 Reading and interpreting tables, charts, and graphs  
 Basic Geometry Skills and Concepts  
 Knowledge of geometric relationships  
 Parallel  
 Perpendicular  
 Determination of area and circumference of circles.  
 Determination of area and perimeter of an ellipse.  
 Determination of facts involving lines tangent to circles.

## COMMUNICATIONS

PERFORMANCE MODES

Speaking  
 Reading  
 Writing  
 Listening  
 Viewing  
 Touching

EXAMPLES

Make oral requisitions for materials  
 Interpret blueprint and written specifications  
 Measure and lay-out pipe according to blueprint or sketch  
 Make written requisitions for materials needed  
 Follow oral instructions  
 Appraise work

SKILLS/CONCEPTS

Terminology, Logic, Gesture, Usage  
 Comprehension, Detail, Proposals, Description.  
 Terminology, Instruction  
 Sketch, Description, Logic, Terminology, Usage  
 Discriminate facts, Logic, Concentration, Note taking  
 Visual analysis, Logic, Discrimination, Detail.  
 Recognition of symbols, Codes, etc.  
 Size, Shape, Temperature

**(TASK STATEMENT) H-D TIG WELD STAINLESS STEEL**

<b>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</b>	<b>PERFORMANCE KNOWLEDGE</b>	<b>SAFETY -- HAZARD</b>
<p>AC/DC Arc Welding Equipment Hi-frequency capability Flow Meter Regulator TIG Welding Torch Tungsten Electrodes Inert Gas Supply Stainless Steel Material Stainless Steel Filler Rod S T, as required</p>	<p>Determine joint design Select electrode size Determine welding position Select polarity Adjust current Adjust inert gas flow Set and adjust hi-frequency Set up work, complete weld according to proper procedure</p>	<p>Refer to Index under Safe Practice: XVIII Electric Arc Welding -- [Items 1 thru 28]</p>
<p><b><u>DECISIONS</u></b></p> <p>Determine joint design Select electrode size Determine weld position Adjust current Adjust gas flow Set and adjust hi-frequency Appraise finished work by visual inspection</p>	<p><b><u>CUES</u></b></p> <p>Job requirements or specs Current required Ease of application Proper penetration Proper shielding Spark intensity, mode, etc. Appearance, penetration, etc.</p>	<p><b><u>ERRORS</u></b></p> <p>Does not meet requirements Improper arc characteristics Poor weld quality Poor weld quality Poor weld quality Electrode contamination Porosity, poor penetration, cracks, etc.</p>

SCIENCE

Simple machines used to gain mechanical advantage—[use of standard tools]  
Effect of heating and cooling on expansion of materials—[controlling distortion]  
Transfer of heat from one body to another—[water cooled torch]  
Arrangement of molecules, atoms and ions and the effect on structure and strength of materials  
[Physical characteristics of inert gases and their function]  
[Different types Tungsten Electrodes and their use Hi-frequency and its function]  
Weldable and non-weldable stainless steels

MATH — NUMBER SYSTEMS

Set of Real Numbers—Positive Rationals  
Fundamental Operations (Calculation)  
Addition algorithm  
Subtraction algorithm  
Multiplication algorithm  
Division algorithm  
Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions  
Basic Measurement Skills and Concepts  
Instruments—[Basic Measurement]  
Measurement: Geometric  
Linear  
Reading and interpreting tables, charts, and graphs  
Scale drawings/floor plans/blueprints  
Basic Arithmetic Skills and Concepts—Ratio and proportion  
[Weldment proportional to parent metal]

COMMUNICATIONS

PERFORMANCE MODES

Speaking  
Reading  
Writing  
Listening  
Viewing  
Touching

EXAMPLES

Make oral requisitions for materials  
Interpret blueprint and written specifications  
Make written requisitions for materials needed  
Follow oral instructions  
Appraise work

SKILLS/CONCEPTS

Terminology, Logic, Gesture, Usage  
Comprehension, Detail, Proposals, Description, Terminology, Instruction  
Sketch, Description, Logic, Terminology, Usage  
Discriminate facts, Logic, Concentration, Note taking  
Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc  
Size, Shape, Temperature

## TASK STATEMENT) III-E TIG WELD ALUMINUM

CA

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
AC, DC Arc Welding Equipment Hi-frequency capability Flow-meter Regulator TIG Welding Torch Tungsten Electrodes Inert Gas Supply Aluminum Material Aluminum filler Rod Standard tools as required	Determine joint design Select electrode size Select filler type/size Determine welding position Adjust current Adjust inert-gas flow Set and adjust hi-frequency Set up work complete weld according to proper procedure Determine preheat needed	Refer to Index under Safe Practice: XVIII Electric Arc Welding [Items 1 thru 28]
<u>DECISIONS</u>  Determine joint design Select electrode size Select filler type/size Determine weld position Preheat to required temperature Adjust current Adjust inert-gas flow Set/Adjust hi-frequency Appraise finished weld by visual inspection	<u>CUES</u>  Job requirement or specs Current required Job Requirements Ease of application Job requirement Proper penetration Proper shielding Mode, Spark intensity Appearance, penetration, uniformity, etc.	<u>ERRORS</u>  Will not meet job specifications Improper arc characteristics Poor weld quality Poor weld quality Poor fusion—appearance Poor weld quality Poor weld quality Electrode contamination Porosity, poor penetration, cracks, etc

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools Effect of heating and cooling on expansion of materials—[controlling distortion] Transfer of heat from one body to another —[water cooled torch] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials [Physical characteristics of inert gases and their function] [Different types Tungsten Electrodes and their use.] [Hi-frequency and its function] Weldable and non-weldable aluminum alloys</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions. Basic Measurement Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings/floor plans/blueprints Basic Arithmetic Skills and Concepts—Ratio and proportion [Weld proportionate to parent metal]</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisitions for materials Interpret blueprint and written specifications Make written requisition for materials needed Follow oral instructions Appraise work</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description. Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>	

## (TASK STATEMENT) III-F TIG WELD CAST IRON

62

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY - HAZARD
<p>AC/DC Arc Welding equipment with High-frequency unit TIG Torch Assembly Tungsten Electrode Inert gas supply Filler rod Grinder Cast iron material S. T. as required</p>	<p>Determine joint design Determine preparation needed Determine electrode-size and type Determine filler rod size and type Determine necessity of preheat or postheat Determine position Determine polarity Determine current setting Determine gas flow Complete weld according to proper procedure</p>	<p>Refer to Index under Safe Practices: XVIII - Electric Arc Welding - [Items 1 thru 28]</p>
<p><u>DECISIONS</u></p> <p>Determine joint design Determine preparation needed Select electrode size and type Select filler rod size and type Select preheat and/or postheat Select position Set polarity Make current setting Set gas flow Appraise finished work</p>	<p><u>CUES</u></p> <p>Job requirement Condition of metal, dirty, rusty etc. Procedure requirement Procedure requirement Weight and shape of casting Better and more efficient results Job requirement Job requirement Job requirement Visual and specification</p>	<p><u>ERRORS</u></p> <p>Lack of fusion and penetration Porosity, poor quality of weld Drop in quality of weld Porosity, poor quality of weld Possible cracks in casting Poor shape of weld bead May not be feasible Porosity, lack of fusions, bad bead shape Contamination of weld and electrode Poor quality of finished job</p>

62

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools] Effect of heating and cooling on expansion of materials [fast cooling may cause uneven contraction, cracks] Transfer of energy from one form to another—[electric energy to heat] Transfer of heat from one body to another—[effect of adjacent areas] Resistance of materials to flow of electrical current—[cable size, electrode size] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[weld] Resistance of materials to change in shape—[cast iron cannot be bent or shaped] [Characteristics of inert gases and function] [Types of tungsten electrodes] [Function of high-frequency] [Filler rods used—cast iron and nickel]</p>	<p>Set of Real Numbers—Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions Basic Measurement Skills and Concepts Instruments—[Basic Measurement] Measurement: Geometric Linear Reading and interpreting tables, charts, and graphs Scale drawings/floor plans/blueprints Basic Measurement Skills and Concepts—Measurement, Non-geometric Temperature [Checking and Controlling]</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p>Make oral requisition for materials Read preheat and postheat temperatures as noted in written or oral instructions Interpret blueprint and written specifications Make written requisitions for materials needed Follow oral instructions Appraise work</p>
SKILLS/CONCEPTS	
<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>	

## (TASK STATEMENT) III-G HARDFACE

64

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>AC DC Arc Welding equipment with High-frequency unit. TIG Torch assembly Tungsten electrode Inert gas supply Steel or Steel alloy Filler rod Grinder</p>	<p>Determine joint design Determine preparation needed Determine electrode size and type Determine filler rod size and type Determine position Determine current setting Determine polarity setting Determine gas flow Complete weld according to proper procedure</p>	<p>Refer to Index under Safe Practice: XVIII Electric Arc Welding [Items 1 thru 28]</p>
<p><u>DECISIONS</u></p> <p>Determine joint design Determine preparation needed Select electrode size and type Select filler rod size and type Determine position Select current setting Select polarity Set gas flow Appraise finished job</p>	<p><u>CUES</u></p> <p>Job requirement Job requirements and condition of metal Metal thickness Job requirement Ease of application Job requirement Job requirement Job requirement Visual appearance and specification</p>	<p><u>ERRORS</u></p> <p>Material waste Poor quality, poor adhesion Poor quality, appearance Poor quality, undersired physical properties Poor shape of bead Poor quality, dilution of bead Poor quality, or not feasible Weld contaminations and oxidation</p>



SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]                      Effect of heating and cooling on expansion of materials—[material size, distortion]                      Transfer of energy from one form to another—[electrical energy to heat]                      Transfer of heat from one body to another—[adjacent areas]                      Resistance of materials to flow of electrical current—[cable size, electrode size]                      Arrangement of molecules, atoms and ions and the effect on structure and strength of materials—[weld and material]                      Resistance of materials to change in shape—[rigid and hard materials]                      [The metallurgy of hardfacing materials]                      [The characteristics of inert gases-function]</p>	<p>Set of Real Numbers—Positive Rationals                      Fundamental Operations (Calculation)                      Addition algorithm                      Subtraction algorithm                      Multiplication algorithm                      Division algorithm                      Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.                      Basic Measurement Skills and Concepts                      Instruments—[Basic Measurement]                      Measurement: Geometric                      Linear                      Reading and interpreting tables, charts, and graphs                      Scale drawings/ floor plans/blueprints</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking                      Reading                      Writing                      Listening                      Viewing                      Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials                      Interpret blueprint and written specifications                      Make written requisitions for materials needed                      Follow oral instructions                      Appraise work</p>
SKILLS/CONCEPTS	SKILLS/CONCEPTS
	<p>Terminology, Logic, Gesture, Usage                      Comprehension, Detail, Proposals, Description, Terminology, Instruction                      Sketch, Description, Logic, Terminology, Usage                      Discriminate facts, Logic, Concentration, Note taking                      Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc.                      Size, Shape, Temperature</p>

#### **DUTY IV. METALLIC INERT-GAS ARC WELDING**

- A. Set up equipment for Metallic Inert-Gas welding**
- B. MIG weld carbon steels**
- C. MIG weld pipe**
- D. MIG weld aluminum**

66

66

## (TASK STATEMENT) IV-A SET UP EQUIPMENT FOR METALLIC INERT-GAS

67

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
<p>Constant Voltage, Direct Current Welding Machine Power Input supply Inert Gas supply Wire-feed assembly and controls Water supply Flow meter regulator Ground and Electrode cables MIG Torch Assembly Filler wire on reel Standard Tools as required</p>	<p>Connect machine to power supply Attach water supply to machine Attach cables to ground and torch Attach flow meter to inert-gas supply Attach filler wire reel to feed assembly Adjust wire feed and current control Adjust voltage Inspect for operation procedure</p>	<p>Refer to Index under Safe Practice XVIII Electric Arc Welding -- [Items 1 thru 28]</p>
<p><u>DECISIONS</u></p> <p>Connect machine to power supply Attach water supply Attach cables to ground and torch Attach flow meter Adjust wire feed current Adjust voltage Appraise operation by actual test use</p>	<p><u>CUES</u></p> <p>Current requirements of machine Needed to keep torch cool Make positive and secure To control shielding gas Amount needed for operation For smooth Arc Proper wire feed, good Arc characteristic, good deposit</p>	<p><u>ERRORS</u></p> <p>Damage to machine Damage torch through overheating Poor connections, Damage equipment Poor weld quality Improper weld deposit Improper wire feed, poor Arc characteristics</p>

## SK STATEMENT) IV-A SET UP EQUIPMENT FOR METALLIC INERT-GAS

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage [use of standard tools]  Work input, work output, friction and efficiency in simple machines  [wire fed assembly operation]  Transfer of heat from one body to another [water cooled torch]  [Physical characteristic of inert gases and their function]  [Different types filler wire]  [Short-arc and Spray Arc]  [Methods of application]</p>	<p>Set of Real Numbers Positive Rationals  Fundamental Operations (Calculation)  Addition algorithm  Subtraction algorithm  Multiplication algorithm  Division algorithm  Order of operations, i.e. Use of parentheses in simplifying arithmetic expressions.  Basic Measurement Skills and Concepts  Instruments — [Basic Measurement]  Measurement: Geometric  Linear  Reading and interpreting tables, charts, and graphs  Scale drawings floor plans/blueprints</p>
COMMUNICATIONS	
PERFORMANCE MODES	EXAMPLES
<p>Speaking  Reading  Writing  Listening  Viewing  Touching</p>	<p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage  Comprehension, Detail, Proposals, Description,  Terminology, Instruction  Sketch, Description, Logic, Terminology, Usage  Discriminate facts, Logic, Concentration, Note taking  Visual analysis, Logic, Discrimination, Detail,  Recognition of symbols, Codes, etc  Size, Shape, Temperature</p>

(TASK STATEMENT) IV-B MIG WELD CARBON STEELS

TOOLS, EQUIPMENT, MATERIALS,  
OBJECTS ACTED UPON

MIG Welding Equipment  
Inert-Gas Supply  
Flow meter Regulator  
MIG Torch Assembly  
Filler Wire Supply  
Standard tools as required

PERFORMANCE KNOWLEDGE

Determine joint design  
Select wire size  
Determine weld position  
Adjust inert gas flow  
Adjust wire feed and current control  
Adjust Voltage  
Set-up work, complete weld according to proper procedure

SAFETY — HAZARD

Refer to Index under Safe Practice.  
XVIII — Electric Arc Welding — [Items 1 thru 28]

DECISIONS

Determine joint design  
Select wire size  
Determine welding position  
Adjust gas flow  
Wire feed and current control  
Adjust voltage  
Appraise finished weld by visual inspection

CUES

Job requirements, specifications  
Current requirements  
Ease of application  
Proper shielding  
Amount needed for operation  
Smooth Arc  
Appearance, uniformity bend, penetration

ERRORS

Will not meet job specifications  
Poor Arc characteristics  
Poor weld quality  
Poor weld quality  
Poor weld quality  
Poor Arc characteristics  
Porosity, penetration too great or too little

## SK STATEMENT) IV-B MIG WELD CARBON STEELS

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]  Work input, work output, friction and efficiency in simple machines  [wire feed assembly operation]  Effect of heating and cooling on expansion of materials—[control distortion]  Transfer of heat from one body to another—[water cooled torch]  Arrangement of molecules, atoms and ions and the effect on structure and strength of materials  [Physical characteristics of inert gases and their functions]</p>	<p>Set of Real Numbers Positive Rationals  Fundamental Operations (Calculation)  Addition algorithm  Subtraction algorithm  Multiplication algorithm  Division algorithm  Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.  Basic Measurement Skills and Concepts  Instruments --[Basic Measurement]  Measurement: Geometric  Linear  Reading and interpreting tables, charts, and graphs  Scale drawings floor plans, blueprints</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking  Reading  Writing  Listening  Viewing  Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisitions for materials  Interpret blueprint and written specifications  Make written requisitions for materials needed  Follow oral instructions  Appraise work</p> <p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage  Comprehension, Detail, Proposals, Description, Terminology, Instruction  Sketch, Description, Logic, Terminology, Usage  Discriminate facts, Logic, Concentration, Note taking  Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc  Size, Shape, Temperature</p>

## (TASK STATEMENT) IV-C MIG WELD PIPE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
<p>MIG Welding equipment: Inert gas supply Filler wire Aligning fixture S, T as required Pipe</p>	<p>Determine joint design Determine alignment procedure Select wire size and type Determine position Adjust voltage setting Set wire feed speed Select gas flow Complete weld according to proper procedure and specifications</p>	<p>Refer to Index under Safe Practice: XVIII Electric Arc Welding-- [Items 1 thru 28]</p>
<p><u>DECISIONS</u></p> <p>Determine joint design Determine alignment procedure Select wire size and type Determine position Adjust voltage setting Set wire feed speed Set gas flow Appraise finished work</p>	<p><u>CUES</u></p> <p>Job requirement-specification Job requirement and procedure Job requirement-base metal More efficient-ease of application Job requirement Current requirement, bead size Job requirement, specification Visual evaluation, specifications</p>	<p><u>ERRORS</u></p> <p>Lack of fusion and penetration Misalignment of weldment Poor quality Poor quality Lack of fusion, poor quality Lack of fusion, poor appearance Appearance; contamination</p>

SCIENCE	MATH — NUMBER SYSTEMS	
<p>Simple machines used to gain mechanical advantage - [use of standard tools] Effect of heating and cooling on expansion of materials [change in material size] Magnetic fields of force--[effects electric Arc characteristics] Transfer of energy from one form to another--[electrical energy to heat] Transfer of heat from one body to another--[effect on adjacent areas] Resistance of materials to flow of electrical current--[cable size, wire size] Arrangement of molecules, atoms and ions and the effect on structure and strength of materials--[weld]</p>	<p>Set of Real Numbers--Positive Rationals Fundamental Operations (Calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of Operations, i.e., Use of parentheses in simplifying arithmetic expressions. Basic Measurements Skills and Concepts Instruments - [Basic Measurement] Measurement: Geometric Angle Measurement, Non-geometric Temperature Reading and interpreting tables, charts, and graphs Basic Geometry Skills and Concepts Knowledge of geometric relationships Parallel Perpendicular Determination of area and circumference of circles Determination of area and perimeter of an ellipse. Determination of facts involving lines tangent to circles.</p>	
COMMUNICATIONS		
PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
<p>Speaking Reading Writing Listening Viewing Touching</p>	<p>Make oral requisitions for material Measure and lay-out pipe according to blueprint or sketch Interpret blueprint and written specifications Make written requisitions for materials needed Follow oral instructions Appraise work</p>	<p>Terminology, Logic, Gesture, Usage Comprehension, Detail, Proposals, Description, Terminology, Instruction Sketch, Description, Logic, Terminology, Usage Discriminate facts, Logic, Concentration, Note taking Visual analysis, Logic, Discrimination, Detail, Recognition of symbols, Codes, etc. Size, Shape, Temperature</p>



## TASK STATEMENT) IV-D MIG WELD ALUMINUM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
MIG Welding equipment Inert gas supply Filler wire S. T. as required Aluminum material Flow Meter Regulator	Determine joint design Determine preparations needed Determine weld position Adjust gas flow Adjust wire feed and current control Adjust voltage Select wire size and type Complete weld according to proper procedure Determine preheat needed	Refer to Index under Safe Practice. XVIII Electric Arc Welding. [Items 1 thru 28]
<b>DECISIONS</b>  Determine joint design Necessary cleaning Position necessary Set as flow Set wire feed and current Set voltage Select wire size and type Appraise finished work Preheat to specified temperature	<b>CUES</b>  Job requirements, Specification Condition of Metal Ease of application Job requirement Job requirement Job requirement Thickness and type of base metal Appraise weld visual and specifications Job requirement, specifications	<b>ERRORS</b>  Not same as specifications Porosity in weld Poor appearance Porosity, poor quality Poor fusion, appearance Poor Arc characteristics Wrong physical characteristics Poor fusion, appearance

## TASK STATEMENT) IV-D MIG WELD ALUMINUM

SCIENCE	MATH — NUMBER SYSTEMS
<p>Simple machines used to gain mechanical advantage—[use of standard tools]  Work input, work output, friction and efficiency in simple machines  [wire feed mechanism]  Effect of heating and cooling on expansion of materials  [change in material size, distortion]  Magnetic fields of force—[effects electric arc characteristics]  Transfer of energy from one form to another—[Electrical energy to heat]  Arrangement of molecules, atoms and ions and the effect on  structure and strength of materials—[strength of weld and material]  [Weldable and non-weldable aluminum alloys, tempers]</p>	<p>Set of Real Numbers: Positive Rationals  Fundamental Operations (Calculation)  Addition algorithm  Subtraction algorithm  Multiplication algorithm  Division algorithm  Order of operations, i.e., Use of parentheses in simplifying arithmetic expressions.  Basic Measurement Skills and Concepts  Instruments [Basic Measurement]  Measurement: Geometric  Linear  Reading and interpreting tables, charts, and graphs  Scale drawings, floor plans/blueprints</p>
PERFORMANCE MODES	COMMUNICATIONS
<p>Speaking  Reading  Writing  Listening  Viewing  Touching</p>	<p><u>EXAMPLES</u></p> <p>Make oral requisition for materials  interpret blueprint and written specifications  Make written requisitions for materials needed  Follow oral instructions  Appraise work</p> <p><u>SKILLS/CONCEPTS</u></p> <p>Terminology, Logic, Gesture, Usage  Comprehension, Detail, Proposals, Description,  Terminology, Instruction  Sketch, Description, Logic, Terminology, Usage  Discriminate facts, Logic, Concentration, Note taking  Visual analysis, Logic, Discrimination, Detail,  Recognition of symbols, Codes, etc.  Size, Shape, Temperature,</p>

## ABBREVIATIONS

Acetyl—Acetylene

M.S.—Mild steel

Oxy—Oxygen

S.T.—Standard tools:

center punch

clamps

cold chisel

combination square

compass

dividers

files

hacksaw

hammer-chipping

hammer-ballpeen

marking crayon

pliers-combination

pliers-vise grips

protractors

screwdriver

scriber

steel rules

tape measure

75

## **INDEX EYE PROTECTION**

Some type of eye protection should be worn for all operations where open flame and/or arc welding is being performed, both by the operator and those who may be required to be close by. The oxy-acetylene, flame and molten puddle, has a high temperature and concentration, emits a large quantity of ultra-violet and infra-red rays which are injurious to the eyes and skin. Special lens in goggles and face shields of a green or amber shade filter out most of these harmful rays while allowing the green, orange and yellow rays to pass through. These lenses come in shades numbered from one to twelve. Two factors must be considered when determining the numbered lense shade to be used for best visibility of puddle detail with the least amount of eye strain and skin burn or injury. First, the intensity of the flame or arc; second, the size of the pool of molten metal. The following is a list of recommended lens shades to be used for different operations:

<b>OPERATIONS</b>	<b>LENS SHADE</b>
Soft soldering and light brazing	No. 1-3
For heavy silver-brazing, bronze welding and brazing; and welding of light gauge metal with open flame (oxy-acet)	No. 4
For medium welding, heavy brazing with oxy-acet	No. 5
For heavy welding and burning with oxy-acet	No. 6
For very light Tig welding (up to 10 Amp) and for short periods of time (one to five min.)	No. 8
For medium Tig welding (10-100 Amp) and light arc welding (stick electrode)	No. 9
For heavy Tig welding and medium arc welding (up to 200 amps)	No. 10
For amp exceeding 200	No. 11-12

These are, of course, all recommended uses. A good rule to follow is to use as dark a lens as possible with maximum visibility and a minimum of discomfort for the operator.

# **INDEX SAFE PRACTICES IN WELDING**

## **I. Introduction:**

Safety is a major objective in every welding shop. It is the most important attitude a operator must learn in becoming a proficient tradesman. Therefore the goal of these safety policies is to provide a strong safety program for the benefit of all involved.

## **II. General Safety Precautions:**

1. Walk—do not run in shop areas.
2. Remember horseplay has no place in the shop.
3. Work with tools, machines and equipment only after having received proper instruction.
4. Get help for lifting heavy or awkward objects.
5. Wear approved eye protection at all times.
6. Report any and all injuries immediately.
7. Never throw objects in shop area, distraction and injury can result.
8. Be careful of long hair around moving parts of machinery.
9. Be considerate for safety of others.

## **III. Safety Precautions for Metal Saws.**

1. When turning on power, stand to one side of saw frame, and adjust speed to suit work.
2. Mount work only when saw is stopped.
3. Support protruding end of work or material being cut so end will not fall and cause possible injury to anyone.
4. Be sure that the blade is in good condition before using.
5. If blade breaks in work, shut off power and do not attempt to disengage blade from work until the machine has come to a stop.

## **IV. Safety Precautions for Drill Press**

1. Use drills that are properly sharpened and that run true.
2. Chuck wrenches must be removed from drill chucks before starting the machine.
3. Never attempt to hold work under the drill by hand. Always clamp work to table.
4. Change belt for speeds only when power is "Off."
5. Run drills at proper speed. Forcing or feeding too fast may result in broken or splintered drills and serious injuries.
6. Keep your head back and well away from any moving part of the drill press.

## **V. Safety Precautions on Grinders—Pedestal Type:**

1. Stand to one side out of line of wheel when starting it up, especially if wheel is new.
2. The face of the wheel must be flat and free from grooves.
3. Make sure the tool rest is only one-eighth inch from the face of the wheel. Check this distance, too much clearance may cause the job to jam the wheel and break it.

4. Do not set tool rest while machine is in motion.
5. Work should be fed slowly and gradually. Using too much pressure or striking wheel suddenly, may cause it to break.
6. Hold job against wheel firmly so that it will not slip out of the hand and cause hands and fingers to come in contact with wheel.
7. Use clamp or other suitable holding devices for grinding short pieces.
8. Stop wheel if it chatters or vibrates excessively. This may be a danger signal that the wheel is not properly balanced or not attached securely to spindle.
9. Always use face shield or goggles even if grinder is provided with protective glass shields.

#### VI. Safety Precaution on Sheet Metal Brake

1. Keep fingers clear of the mouth of the machine when closing down on the metal.
2. Use care when inserting or removing sharp edged sheets.
3. Make sure counterweight bars do not strike others while working.
4. Get assistance when bending large thick material to avoid backstrain.
5. Keep fingers out of pinch area as the metal is bent, especially on maximum capacity bends.

#### VIII. Safety Precautions on Shears and Punch

1. Fingers must be kept out of the cutting or punching area.
2. Keep your attention on the job; avoid distractions while working.
3. Always use properly installed guards.
4. The shear and punch will be operated normally by one person only.

#### IX. Safety Precautions on Squaring Shear

1. Keep fingers clear of the blade and never under the hold down bar.
2. Never reach behind the shear to support metal. This places you in an awkward position, subject to a fall and puts fingers in a blind area.
3. To avoid crushing toes, keep feet clear of the pedal.
4. Use care in handling sheared razor sharp metal.
5. Never cut excessively small pieces on a shear; use hand snips.
6. The shear is a one man machine; use accordingly.
7. In leaning forward as blade is depressed, people tend to keep balance by grasping the top of the large outer-casting. After the blade has descended, it is possible to insert a finger inadvertently into the slide, as the blade returns, a very serious crush can result.

#### X. Safety Precautions for Hand Tools

##### *Hand Tools, General:*

1. Clamp work securely in vises, but do not hammer on vise handles.
2. Remove filings and chips from benches with a brush, not the hands.
2. Do not allow work to project from vise or bench and cause obstructions.
4. Use the correct size wrench for the job.
5. When using cutting tools, direct the cutting action away from you.
6. Mushroom heads on chisels, punches, etc., should be eliminated continuously.
7. Avoid carrying tools in pockets. Screwdrivers, etc. can injure you if you fall.

8. Inspect hand tools before using.
  9. When using tin snips or other similar tools, avoid letting flesh come between the handles. Pinches and blisters generally result.
  10. When using a chipping hammer, chip toward wall or shield to protect others from flying chips.
- XI. Screw Drivers**
1. Select screw drivers to fit screw head being used.
  2. Keep screw driver handle smooth.
  3. Do not use a hammer on a screwdriver handle.
  4. Avoid holding work in the hand when using a screwdriver on it, as it may slip and cause stab wounds.
  5. Never grind a screwdriver to a chisel edge.
- XII. Wrenches**
1. Discard wrenches that are spread.
  2. Select open-end wrenches to fit the job.
  3. When possible, avoid using an *adjustable* or *monkey wrench*.
  4. If a wrench has been burred, grind off the rough spots to avoid cutting the hands.
  5. It is generally safer to pull wrench toward yourself than to push it away from you.
  6. Be sure that your knuckles will clear obstructions when the wrench turns.
- XIII. Hammers:**
1. Hammers that are chipped should be discarded.
  2. Never use a hammer that has a loose or split handle.
- XIV. Chisels:**
1. In using a chisel and hammer, keep the chisel head free from burring by grinding it if necessary.
  2. Where chips may fly, use a shield to protect others.
  3. Hold the chisel and hammer firmly.
  4. Do not use a chisel with a mushroomed head.
- XV. Files:**
1. Always use a file with a handle.
  2. Never use a file as a pry bar.
  3. Keep firm grip on file at all times.
  4. Do not blow filings so that they can go into anyone's eyes.
  5. Make sure the work to be filed is securely mounted.
- XVI. Pliers:**
1. When using pliers, keep hands clear of the pinch area. This may be at the rear of the bolt as well as ahead.
  2. Place hands over short wire pieces, cotter pins or other small items being cut. Such items tend to fly and may cause eye injury.
  3. Remove any burrs caused by pliers which can cause injury.
- XVII. Hacksaws:**
1. Use the correct blade for the job.

2. See that blade is securely fixed in the frame.
3. When the saw breaks through work, ease up on the pressure so that the hand will not strike the work or vise.

#### XVIII. *Electric Arc Welding*

1. Avoid looking at the arc or flash unless equipped with appropriate dark glasses.
2. Helmets and welding goggles must be free of cracks or holes permitting penetration of intense light.
3. Wear protective clothing to help protect the skin from intense rays.
4. Always wear gloves. Leather gauntlet type that can be thrown off are recommended.
5. Where necessary, wear leather aprons, arm coverings or other protection to protect from molten metal or hot sparks.
6. Where a helper is used, he must be protected the same as the welder.
7. Wear high type shoes rather than undercut shoes.
8. Always wear eye protection when chipping. Never chip if there is a possibility someone nearby without glasses will be struck by flying chips.
9. Keep sleeves and pants cuffs rolled down and collar buttoned up.
10. Never touch a piece of metal in the welding area if uncertain about the temperature.
11. Mark hot metal to read "HOT."
12. Do not handle excessively hot metal with gloves unless cool area beyond hot spot permits safe handling.
13. Exercise good judgement in selecting welding jobs. Automotive work is especially hazardous due to fuel tank, fuel line, hydraulic lines, flammable upholstery, etc.
14. Special metals require the use of respirators to protect welders from harmful fumes. Adequate ventilation is always desirable, especially when welding galvanized materials.
15. Toxic gas, phosgene, is formed when the ultra-violet rays of an electric arc come in contact with chlorinated degreasing solvents. Metal cleaned with carbon tetrachloride and trichlorethylene should not be welded until thoroughly dried.
16. Never strike an arc on compressed air cylinders.
17. Work in dry area.
18. Do not get wound up in your work! Keep cables free from your body so you can move freely, especially should your clothing ignite or some other such accident occur.
20. Ground work before turning on welder.
21. Do not change polarity or connections while a welder is being used.
22. Keep floor free of electrodes once you begin to weld. They could cause a slip or fall.
23. Place stubs in metal container.
24. Never tack weld without a helmet.
25. Keep clamps and other tools off the floor and put away. They can cause a fall.
26. Ground the work before turning on welder.
27. Keep clamps and other tools off the floor and put away. They can cause a fall.
28. Replace the cables by coiling them to eliminate tripping hazards.

#### XIX. *Oxy-Acetylene Welding*

1. Before attaching a regulator to a cylinder valve, "crack" the valve to blow out dust and dirt.



2. Do not use oil on the torch, blow pipe, valves, regulators, or any other portion of the equipment.
3. Check for leaks whenever you change tanks or suspect a leak.
4. Leaks around equipment should be checked with soapy water, never a flame.
5. Should you suspect a leak in any equipment, stop until repairs are made.
6. Avoid the use of pliers on apparatus. Use torch wrench and turn right for oxygen connections and left for gas or acetylene connections.
7. Keep cylinders in upright position.
8. Open cylinder valves gradually.
9. Open the oxygen valves wide to prevent leakage.
10. Open acetylene cylinder valve one-eighth to one-quarter turn.
11. Keep wrench on acetylene cylinder valve while in use so it can be shut off quickly if necessary.
12. Under no circumstances will acetylene pressure exceed 15 pounds. If used in excess of this amount, an explosion may result.
13. Make sure connections are tight when you change tips or other apparatus. Do not overtighten.
14. Do not use oxygen to blow dirt off your clothes.
15. Use correct type eye protection for all operations.
16. Keep your welding equipment in good, clean, dry condition.
17. Use ventilating system or means of ventilation provided.
18. Keep welding area neat, clean, and dry.
19. Make certain the fire extinguisher is in place and that you know how to use it.
20. Do not permit autos or equipment to run over the hoses. Protect them from sharp objects, kinks, etc.
21. Keep the hose out of the way so it does not become a tripping hazard.
22. Make sure you do not drag the hose over hot metal scrap when cutting.
23. Use flint spark lighters, never matches or cigarette lighters.
24. Purge oxygen and acetylene line before lighting torch.
25. Use special care when cutting so hot pieces do not fall or tumble onto feet. Do not stand with feet so close to the cutting that they are subject to intense heat, sparks, and molten metal.
26. Never lay down or hand up a lighted torch or blowpipe and leave welding station.
27. Hot metal should be marked "HOT" with chalk or soap stone.
28. Adjusting screws on regulators should always be released when not in use. Turn the screw out counter clockwise.
29. Never allow a cylinder to fall. They are under high pressure internally and can explode if ruptured by a sudden shock. Always secure cylinder to a stationary object.
30. Never use oxygen or acetylene directly from tanks without the use of regulators.
31. Cylinders should not come in contact with electric wires.
32. Never tamper with the fusible safety plugs.
33. Acetylene piping, hoses and fittings should be color coded "Red."
34. Never "crack" a cylinder in the vicinity of an open flame or fire source.
35. Keep protective cylinder valve covers secured on cylinders when not in use.

81